THE FRAMEWORK OF ENVIRONMENTAL CONSIDERATIONS IN THE JAMES BAY PROJECT

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1.- The James Bay Project

2.- Functional organization of the James Bay Energy Corporation

3.- Functions of the environment department

4.- Bio-physical inventories and Monitoring

5.- Major problems encountered

Note: Plates are presented in appendix.

Notes presented at the workshop on Environmental effects of reservoirs, Freshwater Institute, Winnipeg, October 1, 2, 3, 1974.

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October 1974

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1.- The James Bay Project

The joint decision by the Quebec Hydroelectric Commission and by the administration board of the JBEC to begin the hydroelectric development of the northern part ot the James Bay territory implies the following features, retained after comparison of many possible alternatives:

- The construction of four power houses on the La Grande river: LG1, LG2, LG3 and LG4;
- The diversion of the head waters of the Caniapiscau river from lake Duplanter to the basin of the Laforge river, tributary of the La Grande river up-stream from LG4;
- The diversion of the waters of Eastmain and Opinaca rivers, up-stream from the LG2 site.

Total installed capacity of the four power houses is 10,340,000 mW, the regulated flow at LG1 being 117,000 ft^3/s, compared to a natural average of 62,000 ft^3/s.

The adoption of this alternative called "La Grande Complex (1974)" allows for an eventual development of the southern region of the James Bay territory, following a scheme that was previously known as the "Nottaway-Broadback-Rupert Complex".

Plate 1 gives the general location of the La Grande Complex, plate 2 illustrates the main features of this complex; plate 3 states the principal characteristics of its components and plate 4 gives the areas of the reservoirs to be created.

2.- Functional organization of the James Bay Energy Corporation

The organization chart of the James Bay Energy Corporation is presented in plate 5, whereas that of the Environment department is given in plate 6.

Environment Department

The Environment department is under the responsability of a member of the Management Committee of the JBEC and consists of three functional divisions:

- "Ecology" consists of specialists in different fields of ecology, which are responsible of the scientific contents of the survey programs and of the laboratory analysis, interpret the results and prepare the scientific part of the environmental reports;

- "Environmental Engineering" consists of general practitioners who follow in all details the projects being studied, prepare environmental reports, give practical recommendations as to the engineering and construction of the works, prepare and implement environmental practices in the field, and maintain close relations with engineers, builders and eventually operators;

- "Bio-physical surveys" is responsible of the logistics and the execution of studies and surveys in the field and in laboratory.

Each of these divisions has an extension in the field, all field activities being under the responsability of the field director of environment, which reports to the manager of the Environment department.

The approved personnel to execute these functions in 1974 is shown on plate 7.

Apart from the in house personnel, JBEC has given several outside contracts: one to the University of Montreal for the operation of a freshwater ecology laboratory; to INRS (Eau) in the field of limnology; to the Centre d'Etudes Nordiques of Laval University in the field of ichthyology.

3.- Functions of the Environment department

The policy of the JBEC in regard to the protection of the environment is as follow:

a) The corporation must make sure that all laws and regulations dealing with protection of the environment are observed;

b) The corporation must make sure that at all stages of planning of engineering and of construction, environmental considerations be included into decision making on the same bases as technical and economical considerations.

In this respect, the Environment department of the JBEC has its activities spread over all the territory covered by the development of the La Grande River and the adjacent rivers to be diverted.

The final objectives of the department are to interact directly in all stages of project realization, to make recommendations on all actions or mitigating measures that could contribute either to maintain the quality of environment or to enhance its resources, by making the demonstration of the benefits or of the social justification of these recommendations.

The mandate of the department is thus:

- To prepare, organize and realize bio-physical surveys on the territory affected by the project;
- To install stations for monitoring of the bio-physical parameters in order to make a scientific evaluation of the real impacts of the project;
- To prepare environmental reports on all projects at the project engineering stage;
- To make recommendations to the Management Committee concerning the engineering and construction of the project;
- To see that construction is being done respectfully to the laws and existing regulations together with added guide-lines prepared by the department.

4.- Bio-physical inventories and Monitoring

The evaluation of the impacts on environment of the project and the preparation of specific recommendations as to the engineering, construction and eventually operation details of the project must rely on an adequate knowledge of the bio-physical mechanisms involved and of the importance of the different resources of the territory.

Classification of bio-physical studies:

To this respect, three types of inventories have been defined:

- Regional studies: to acquire general knowledge on regional basis on all bio-physical elements of the territory.

  These studies are been done under the scope of an agreement between the federal government and the JBDC; in this agreement, the JBEC is particularly responsible of all studies in the freshwater ecology field, together with supplying logistics to other programs.

  In the freshwater field, the regional studies take two forms: on one hand, mapping of the aquatic ecosystems of the territory and on the other hand basic studies of the different elements of the food chain, which are being conducted in a research area of about 40 square miles which will also serve as reference for the bio-physical monitoring of reservoirs.

- Local studies: to acquire local knowledge at the sites of futur reservoirs, diversions and in estuaries. These studies are more particularly oriented to the detailed evaluation of the impacts of each project in order to be able to term specific recommendations as to the mitigating measures, structures or special work needed for enhancement of the resources and the protection of the environment.

- Bio-physical monitoring: the objective of the bio-physical parameters monitoring network is to evaluate, in relation to the pre-project conditions and by comparison to reference stations not affected by the project, the real modifications that will happen after the project, so as to be able to understand ecological mechanisms involved and aid to the management of the project.

  At each site, the monitoring will consist of the qualitative and quantitative observations of all bio-physical parameters

that can be affected by the project. It is done in three steps: the pre-modification period which last three years; the period of modification that last five years following impoundment of reservoirs (or the diversion in the case of diverted rivers) and during which the same observations will be made and at the same frequency then at the precedent stage; the post-modification period of illimited duration, during which observations are made every five years.

Long term program

Plate 8 gives the long term program of the bio-physical inventories in relation to the construction schedule; this program contains all activities we have just described.

Note that:

- For regional studies, this program covers only the freshwater ecology field, other domains being dealed with by other groups working with the bio-physical agreement under similar approach.

- For local studies, this program covers all domains, whether they are being executed by the JBEC or by other programs of the agreement.

- As for monitoring, it also covers all domains, the aquatic part being executed by JBEC; modalities for the execution of the other domains remain to be defined, due to the fact that the bio-physical agreement with the federal government will have elapsed at the time where the actual monitoring is scheduled to begin, unless this agreement be renewed.

The operation of the monitoring network will start in 1975 on an experimental basis,the first permanent station being scheduled to start at the beginning of 1976 at LG2 and at other sites later on as indicated.

As an example of the type of studies done in the field of freshwater ecology, plate 9 gives the title of the programs conducted in 1974 by the JBEC.

The JBDC-DOE agreement

This agreement was signed in November 1972 and its five years objective is to conduct bio-physical inventories and studies to permit an assessment of environmental impacts of the development of this territory and the exploitation of its natural resources.

This agreement is essentially a coordination mechanisms that permits funding of programs that are being executed other by the federal government, by provincial departments or others.

The administration of this agreement is done by a three members committee, representing the federal government, the provincial government and the JBDC.

The annual budget is 1.5 million dollars for programs of national interest, all of which being financed by the federal government and 1 million dollars for programs of mutual interest, 50% of which being financed by the federal government.

5.- Major problems encountered

Without going into the details of the following subjects, which will be done much better than we can by other speakers at this workshop, we think it is useful to identify the types of difficulties, looked at from a management standpoint, we have encountered since the beginning of our experience in that field:

- Impact assessment:
  What modifications will occur at each trophic level and how will these modifications interact to bring about changes in the quality and the quantity of the resources.

- Impact evaluation:
  What populations have interests in each of the resources of the territory and consequently how each population will be positively or negatively affected by the modification of these resources.

- Mitigating measures:
  What techniques, methods, etc... can be envisaged to counteract negative impacts or to take advantage of existing potentials; what will be the net effect of these methods on the quality and quantity of the resources; what are the costs involved and what is the reliability of the methods.

- Planification of bio-physical inventories:
  Given a fixed budget, how much should be spent, proportionally, on each of the numerous research or survey programs that can be thought of.
  - Prior to the decision, in order to evaluate if the project is to be done or not;

  - Before the construction, to determine how the project is to be done;
  - For the systematic monitoring of modifications.

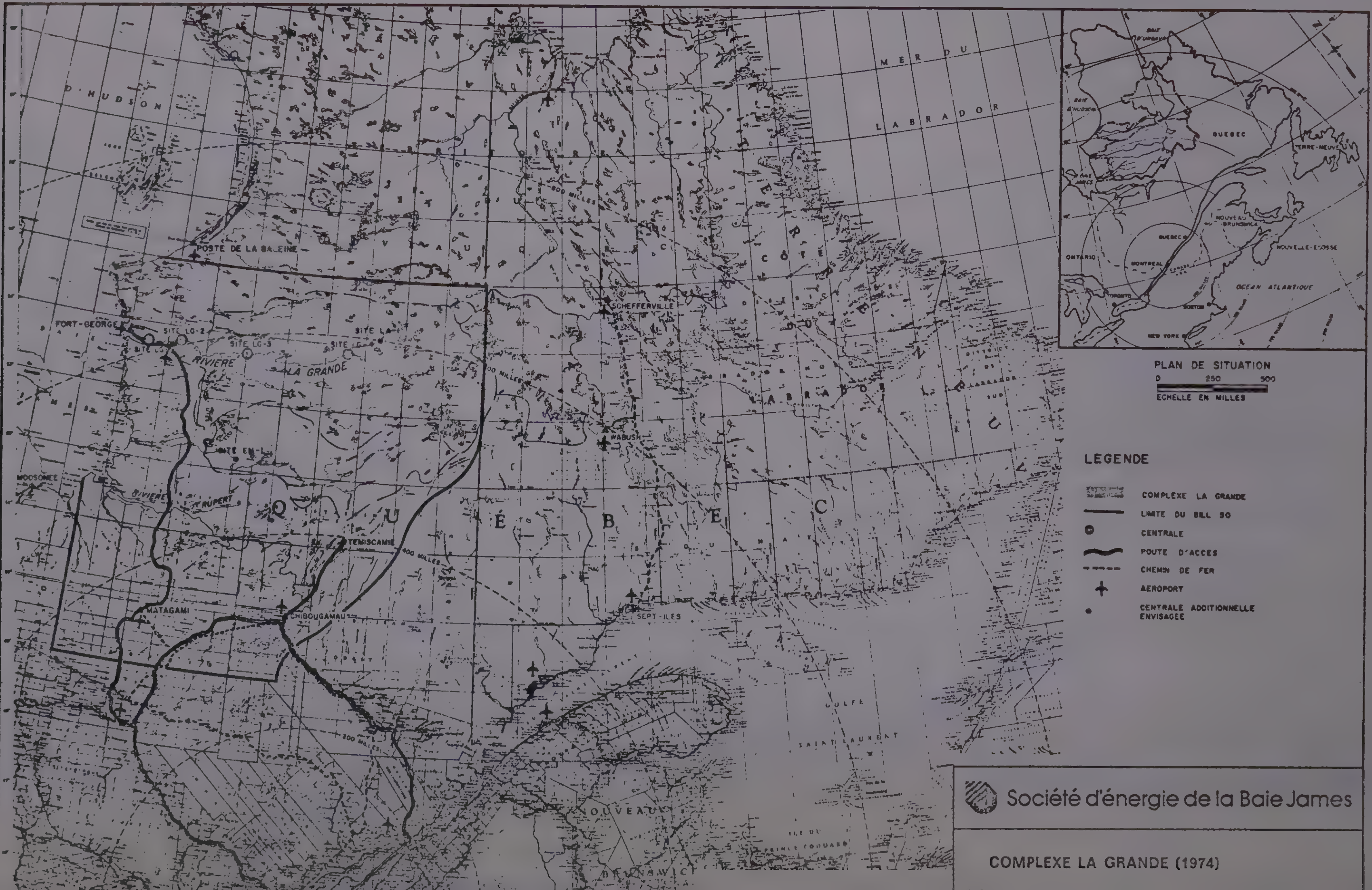
- Decision making on mitigating measures:
  Given a fixed investment budget, on what resource(s) should the money be spent, where and to the benefit of what population(s).

May we remark that attempt in answering these questions in global perspective can be made subjective or biassed by specific constraints brought by political, legal or social pressures.

The previous questions imply that any research team involved in the study of reservoirs and their environmental effects must be completely pluridisciplinary in order to seize the global aspects of the problems involved and to contribute comprehensive inputs for decision making and at the same time feeding back this input in research planification.

APPENDIX

Plate no.	TITLE
1	Location of the La Grande Complex
2	The La Grande Complex (1974)
3	La Grande Complex - Main Features
4	Areas of reservoirs
5	General organization chart - JBEC
6	Organization chart - Environment
7	Approved staff - Environment (1974)
8	Bio-physical inventories - Long term program
9	Freshwater ecology - 1974 programs



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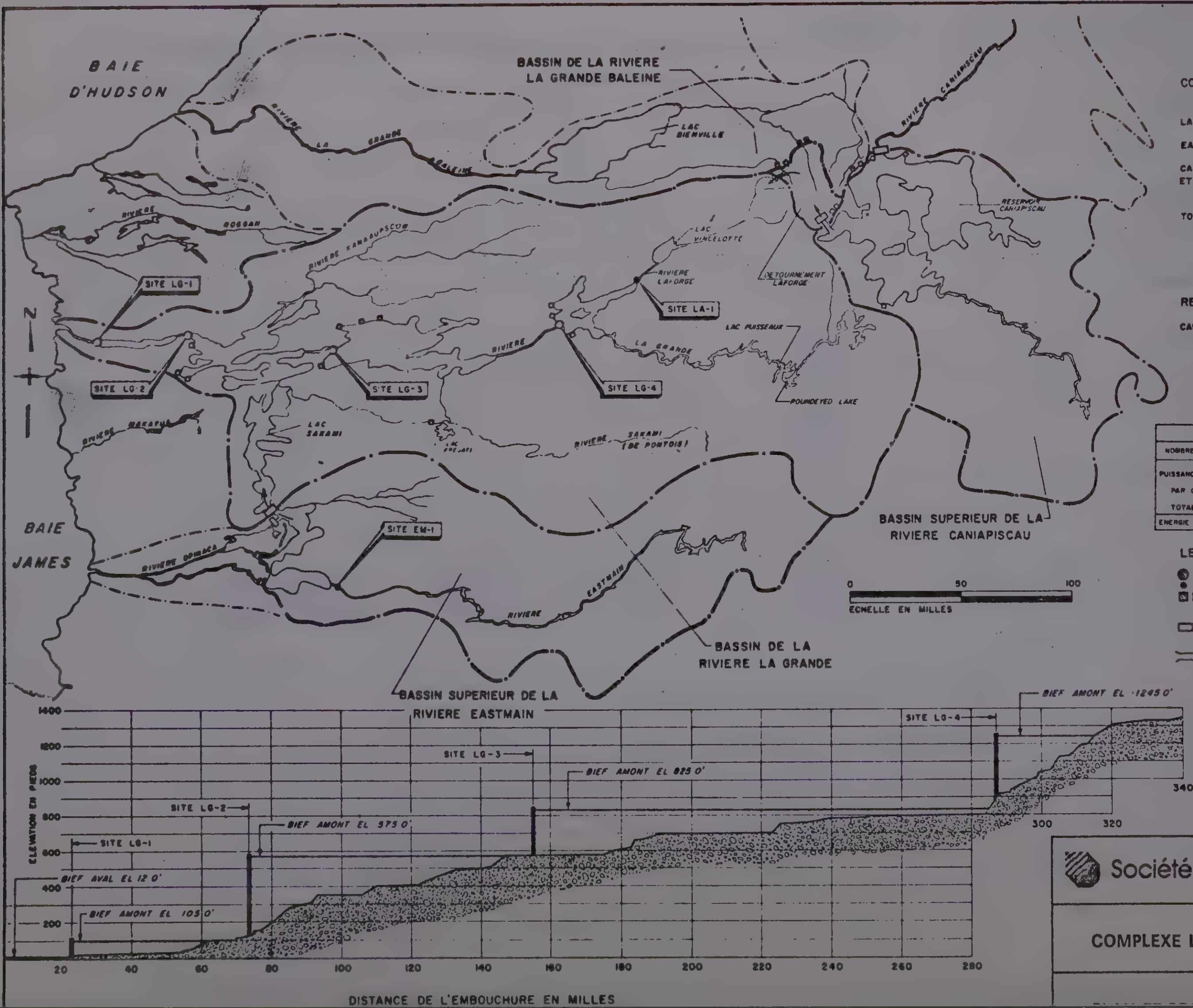
COMPLEXE LA GRANDE (1974)



CONTRIBUTION DES BASSINS

LA GRANDE	37,850 MILLES CARRES
EASTMAIN SUPERIEURE— — —	15,550 MILLES CARRES
CANIAPISCAU SUPERIEURE ET DETOURNEMENT LAFORGE _	14,865 MILLES CARRES
TOTAL . . ┃- - - - - - -	68,265 MILLES CARRES

RESERVOIR

CANIAPISCAU— EL 1750.0 MAX. 1400 g.p.s.

PUISSANCE AUX CENTRALES

SITES	LG-1	LG-2	LG-3	LG-4	TOTAL
NOMBRE DE GROUPES	10	16	10	8	44
PUISSANCE INSTALLEE (MW)					
PAR GROUPE	116	333	176	259	—
TOTAL	1160	5328	1760	2072	10340
ENERGIE GARANTIE (TW-HRE)	7.3	35.3	12.1	14.3	69.0

LEGENDE

●	CENTRALE
•	CENTRALE ADDITIONNELLE ENVISAGEE
▣ ▣ ▣	DIGUES
▭	OUVRAGE REGULATEUR EVACUATEUR DE CRUES
)(	CANAL OU AMELIORATION DE CHENAL

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COMPLEXE LA GRANDE (1974)

COMPLEXE LA GRANDE (1974)

CARACTÉRISTIQUES PRINCIPALES

Emplacement	Description	Cote (pi)		Réserve utile (Gpi^3)	Nombre de groupes	Puissance installée (en MW)	Énergie annuelle (en milliards de TW - Hre)
		Max.	Min.				
LG 1	Centrale	105	100	4	10	1180	7.3
LG 2	Centrale	575	550	690	16	5328	35.4
LG 3	Centrale	825	798	530	10	1760	12.0
LG 4	Centrale	1245	1208	250	8	2072	14.3
Caniapiscau	Réservoir	1750	1718	1400	—	—	—
Eastmain-Opinaca-La Grande	Détournement	720	702	220	—	—	—
Laforge	Détournement	1590	—	—	—	—	—
Frégate	Détournement	1053	—	—	—	—	—
TOTAL				3094	44	10340	69.0

Note: Deux centrales auxiliaires peuvent être ajoutées au complexe, les centrales EM 1 sur la rivière Eastmain et LA 1 sur la rivière Laforge, pour augmenter la puissance à environ 11 300 MW.

PLATE 3

AREAS OF RESERVOIRS

	AREA IN SQUARE MILES		
	NATURAL	FUTURE	SUBMERGED
LG 1	5	30	25
LG 2	80	1 095	1 015
LG 3	110	360	750
LG 4	20	330	310
CANIAPISCAU	385	1 440	1 055
EASTMAIN	140	505	375
TOTAL	740	3 760	3 530

AREA OF DRAINAGE BASINS: 68 265 SQ. MI.

NATURAL WATER / LAND RATIO: 0.15

PERCENTAGE OF LAND FLOODED: 5.2 %

FUTURE WATER / LAND RATIO: 0.20

PLATE 4

General organization chart

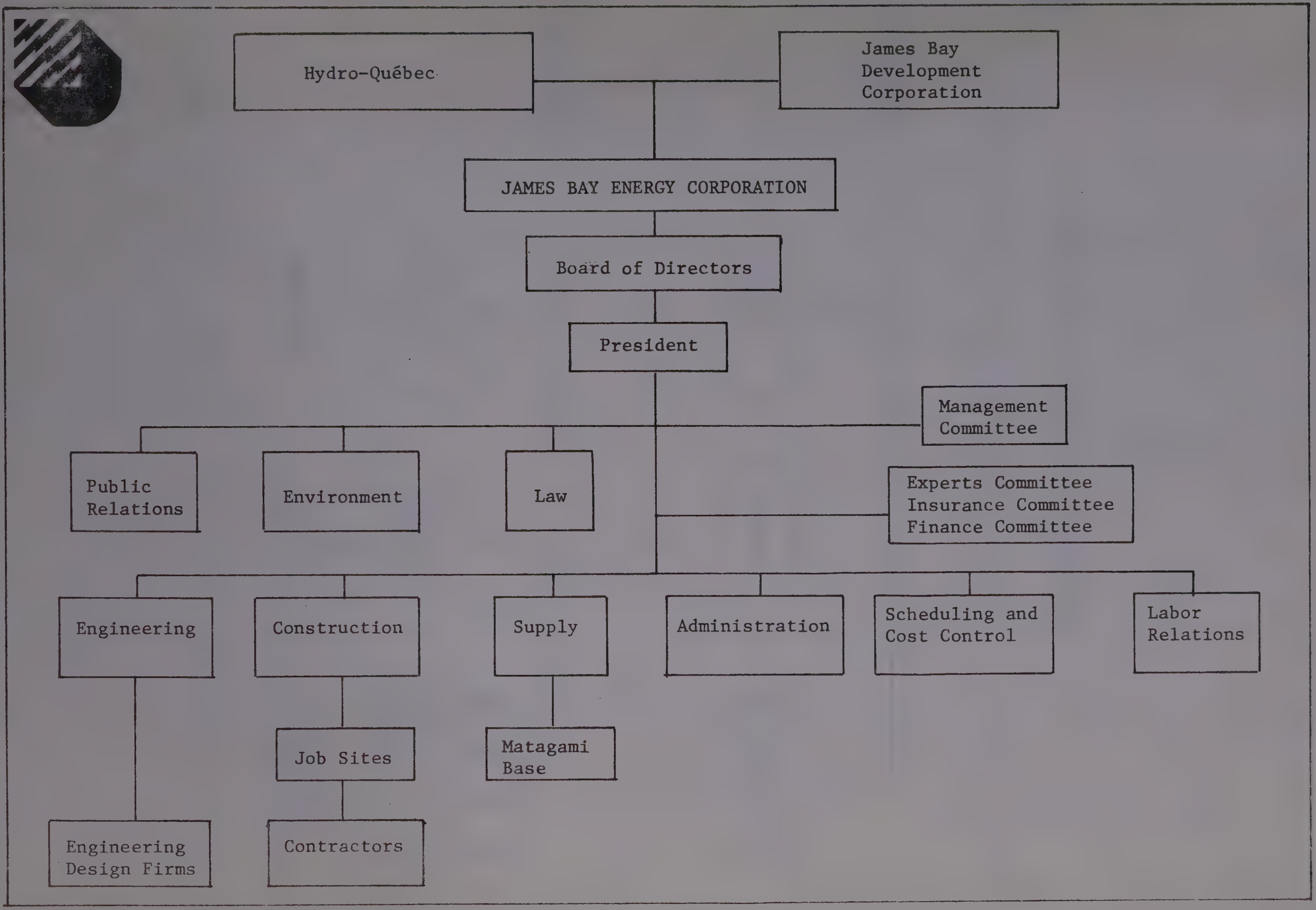

PLATE 5

ORGANIZATIONAL CHART – ENVIRONMENT

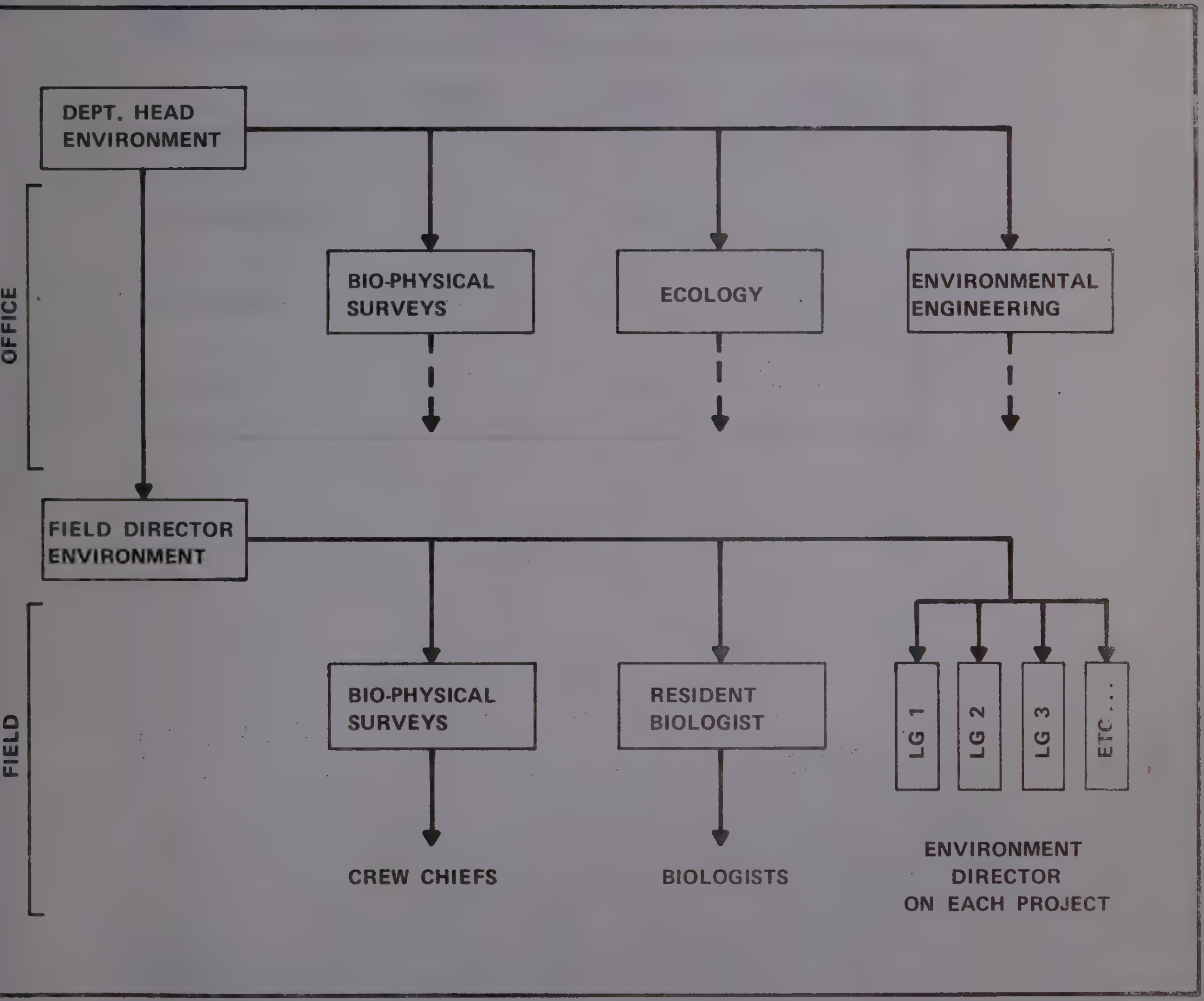

PLATE 6

APPROVED STAFF — ENVIRONMENT
1974

	OFFICE	FIELD	TOTAL
PERMANENT	15	15	30
TEMPORARY	5	5	10
SEASONAL	5	25	30
TOTAL	25	45	70

Plate 7

BIO-PHYSICAL INVENTORIES – LONG TERM PROGRAM

			1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
REGIONAL STUDIES	MAPPING		40%	20%	20%	20%									
	BASIC STUDIES	LG 2 AREA		X	X	X	X	X	X	X	X	X	X	X	X
		UPPER LA GRANDE AREA				X	X	X	X	X	X	X	X	X	X
LOCAL STUDIES		LG 1 DOWNSTREAM	P.I.	C.I.				P.M.	P.M.	P.M.	M	M	M	M	M
		LG 1	P.I.	C.I.				P.M.	P.M.	P.M.	M	M	M	M	M
		LG 2	P.I.	C.I.		P.M.	P.M.	P.M.	M	M	M	M	M	P	P
		LG 3	P.I.	C.I.				P.M.	P.M.	P.M.	M	M	M	M	M
		LG 4			R	P.I.	C.I.				P.M.	P.M.	P.M.	M	M
		CANIAPISCAU-LAFORGE	P.I.	C.I.			P.M.	P.M.	P.M.	M	M	M	M	M	
		EASTMAIN OPINACA-LA GRANDE	R		P.I.	C.I.		P.M.	P.M.	P.M.	M	M	M	M	M

LEGENDE:			
R	RECONNAISSANCE	P.M.	PRE-MODIFICATION
P.I.	PRELIMINARY INVENTORY	M	MONITORING DURING
C.I.	COMPLETE INVENTORY	P	POST MODIFICATION

PLATE 8

FRESHWATER ECOLOGY
1974 PROGRAMS

PROGRAM Nº	DESCRIPTION	
30	MAPPING OF AQUATIC ECOSYSTEMS	– LG2 AREA
31		– EASTMAIN AREA
32		– UPPER CANIAPISCAU
33		– LAFORGE AREA
34		– LG2 BASIC STUDIES AREA
35	COMPLETE INVENTORY	– LG1 RESERVOIR
36	PHYSICO-CHEMICAL	(BASIC STUDIES AREA)
37	PLANKTON AN BENTHOS	(BASIC STUDIES AREA)
39	ANADROMOUS WHITEFISH	– EASTMAIN AND LA GRANDE RIVERS
40	BASIC STUDY	– WALLEYE
41		– OUANANICHE OF THE CANIAPISCAU AREA
42		– SALMON OF THE KOKSOAK RIVER
44		– LAKE WHITEFISH
45		– BROOK TROUT
46		– AQUATIC VEGETATION
47		– INSECTS

PLATE 9

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